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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 633 678 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
19.07.2000 Bulletin 2000/29

(51) Int. Cl.[7]: **H04L 12/18**, H04L 12/56

(21) Application number: **93201896.3**

(22) Date of filing: **29.06.1993**

(54) Resequencing method and resequencing device realizing such a method

Verfahren und Gerät für sequentielle Rückordnung

Procédé et dispositif pour la remise en séquence

(84) Designated Contracting States:
BE DE ES FR GB IT NL SE

(43) Date of publication of application:
11.01.1995 Bulletin 1995/02

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EP 0 633 678 B1

Printed by Xerox (UK) Business Services
2.16.7 (HRS)/3.6

Description

[0001] The present invention relates to a method for resequencing information packets of an information packet stream transmitted from a transmitter station to a receiver station over a network and identified by sequence numbers.

[0002] Such a method is well known in the art, e.g. from the Euro-PCT Application No. 438415 (Henrion 17) Therein, the network is a multipath self routing switch, so that packets may follow different paths therein and may therefore be out of sequence upon their arrival in the receiver station. In this station the packets are then resequenced based on sequence numbers constituted by time stamps allocated to them in the transmitter station.

[0003] This known resequencing method is however not applicable when the information packet stream comprises two or more types of intermixed packets which have to be in sequence in the receiver station, not only within each type they belong to but also with respect to each other. This is for instance the case with a so called Switched Multimegabit Data Service (SMDS) network as described in the Bellcore specifications TR-TSV-000772 (corresponding CCITT Draft Recommendation I364, Geneva, June 1992 or ETSI final draft pr ETS 300217 September 1992) and wherein packets belonging to a same information stream also called session or message can be transmitted either as first packets with group addresses from the transmitter station to a plurality of receiver stations, including a predetermined receiver station, via arbitrary paths, which means that they can be received out of sequence in the latter receiver station, or as second packets with individual adresses from the transmitter station to the predetermined receiver station where they are then received in sequence. As all these packets, i.e. as well the first as the second ones, belong to a same information stream, the first packets have to be resequenced in the predetermined receiver station to be in sequence not only with respect to themselves, but also with respect to the second packets. Resequencing these first and second packets with the help of sequence numbers or time stamps allocated thereto as in known systems has the important drawback that it is impossible to know upon receipt of a sequence of first and second packets whether packets have been lost, and thus whether one has to wait for those possibly lost packets.

[0004] Indeed, the transmitter station which is not aware to which message a packet belongs,has to sequentially allocate sequence numbers/time stamps to the packets it sends out, without taking into account to which message these packets belong. As a result, the packets received by a receiver station are not numbered consecutively because first packets are sent to all receiver stations, while second packets are sent to specific ones. Considering for instance a transmitter station which has to send 10 packets numbered 1 to 10 of which packets 1 to 3 are first packets, 4 to 6 are second packets intended for a receiver station Ra, 7 and 8 are second packets intended for Rb and 9 and 10 are first packets, Ra then receives packets 1 to 6, 9 and 10 and Rb receives packets 1 to 3, and 7 to 10. The packets received are thus not numbered consecutively and it is impossible for the receiver stations to know whether the gaps in the numbering are due to packet loss or not.

[0005] To be noted that the above reasoning is also applicable to time stamps.

[0006] The same problem but related to multicasting is described in the article "Multicasting to Multiple Groups over Broadcast Channels" by Gopal et al, pages 79-81 of the Computer Networking Symposium papers (April 1988, Washington , USA).

[0007] The solutions proposed therein rely on the inclusion of additional information in the message stream to indicate to every destination the sequence numbers of the messages destined to it, which obviously imply an increase of overhead bandwidth, thus negatively influencing the bandwidth available for transmission of data.

[0008] An object of the present invention is to provide a resequencing method of the above known type but which is more particularly applicable when the information packet stream includes first packets which may be received in said receiver station out of sequence with respect to each other or with respect to second packets which are always received in sequence, and which has not got the above mentioned drawback.

[0009] According to the invention, this object is achieved due to the fact that in the latter case said method includes the steps of :

- in said transmitter station, allocating predetermined first sequence numbers to said first packets and allocating to each second packet following a first packet a second sequence number which is related according to a predetermined relation to the predetermined first sequence number allocated to this first packet; and
- in said receiver station, resequencing said first and second packets according to their first and second sequence numbers respectively.

[0010] By linking the sequence numbers of the first and the second packets, and allocating predetermined first sequence numbers to the first packets an easy resequencing is possible and a receiver station always knows whether, upon receipt of a packet, it has to wait for a previous one not yet received.

[0011] Further characteristics of the invention are that said allocated predetermined first sequence numbers form an increasing/decreasing monotonous series and that said second sequence number allocated to said second packet is equal to the predetermined first sequence number of the first packet preceding said second packet.

[0012] This choice of the predetermined first sequence numbers and of the predetermined relation makes the resequencing even easier due to this simple relationship between the first packets with respect to each other and between the first and the second packets.

[0013] Known resequencing devices realizing the known resequencing methods are obviously restricted in the same way as described above with relation to the known resequencing methods.

[0014] The present invention therefore also relates to a resequencing device for resequencing information packets of an information packet stream transmitted from a transmitter station to a receiver station over a network and identified by sequence numbers characterized in that, when said information packet stream includes first packets which may be received in said receiver station out of sequence with respect to each other or with respect to second packets which are always received in sequence, said resequencing device includes :

- a sequence number allocation means located in said transmitter station and which is able to allocate predetermined first sequence numbers to said first packets and to allocate to each second packet following a first packet a second sequence number which is related according to a predetermined relation to the predetermined first sequence number allocated to this first packet; and
- a resequencing means located in said receiver station and which is able to resequence said first and second packets according to their first and second sequence numbers respectively, which realizes the new resequencing method.

[0015] The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawing representing a communication system which includes a resequencing device C1, P1, B, P2, C2, T according to the present invention and which realizes a resequencing method also according to the present invention.

[0016] This communication system includes a Switched Multimegabit Data Service network SMDS to which 4 user terminals U1 to U4 are coupled via respective identical interworking units IWU1 to IWU4 of which only IWU1 and IWU2 are partly represented in detail. More specifically of IWU1 a segmenting circuit S for segmenting a message Min received from U1, a processing circuit P1 and a counter circuit C1 are shown, and of IWU2 a processing circuit P2 is shown together with a counter module C2, a buffering module B, a timer circuit T and a reassembly circuit R for reassembling packets Pin received from P2, into a message Mout destined for U2.

[0017] C1 and P1 together constitute a sequence number allocation circuit and P2, C2, B and T are part of a resequencing circuit, both circuits constituting a sequencing device.

[0018] C1 and C2 are wrap-around counters, i.e. counters which after having reached a maximum value automatically restart counting from their initial value.

[0019] P1 and P2 control C1 and C2 respectively and retrieve respective counter values therefrom.

[0020] P2 is additionally connected to B and T by means of bidirectional links.

[0021] S passes to P1 packets obtained by segmenting a message Min and in response P1 generates outgoing packets Pout for transfer over SMDS. Therein these packets are routed to e.g. IWU2 where they are received by P2 as incoming packets Pin. The latter are after processing and possible buffering passed to R for reassembly into Mout.

[0022] C1, S, P1, B, P2, R, T and C2 are not described in further detail because, for a person skilled in the art, their realization is obvious from their following functional description.

[0023] Packets belonging to a same message or information flow can be transmitted over SMDS in two ways, i.e. as packets of a first type, hereafter called first packets, having a group destination address and which are sent to all interworking units belonging to a corresponding group, e.g. IWU1 to IWU4 and as packets of a second type, hereafter called second packets, having an individual destination address and which are transmitted from point to point, e.g. from IWU1 to IWU2. Individual address packets or second packets are hereafter indicated by Ix where x is the sequence number of the packet in the message it belongs to, and in the same way group address packets or first packets are called Gx.

[0024] It has to be noted that the counter module C2 includes as many counter circuits as there are interworking units which can send first packets to it, but for simplicity reasons it is assumed that C2 only includes a single counter circuit allocated to thefirst packets received from IWU1. Extension to a counter module with a plurality of counter circuits is obvious to a person skilled in the art.

[0025] P1 sets C1 to an initial value, e.g. 0, at start-up of the sequence allocation circuit. Whenever a packet is afterwards received from S for transmission over SMDS, P1 gets the current counter value provided by C1 and assigns it to that packet when it is a second packet. On the contrary, when the received packet is a first packet then P1 increments C1 by a predetermined value, e.g. 1, and assigns the thus obtained value to that packet. As a result,second packets always have the same sequence number as the preceding first packet, except for second packets sent immediately after start-up of the sequence allocation circuit. These packets indeed have sequence number 0 whilst there is no preceding first packet with value O.

[0026] At the receiving side, e.g. IWU2, and upon start-up of the resequencing circuit, C2 is set by P2 to the initial value of C1 by means of a synchronization scheme. Synchronization schemes as the one used in this embodiment are well known in the art and therefore the used scheme is not described in detail. As will become clear from the following, the value of C2 at a given instant in time indicates the sequence number of the first packet which was the last one to be passed to R, and its value incremented by 1 indicates which first packet is expected to be received next.

[0027] To be noted that the maximum value of C1 and C2 at which the wrap-around occurs has to be the same one for both and that this maximum value has to be chosen in such a way, that the receiver station never has to process two or more first packets with the same sequence number at the same time.

[0028] When a packet Pin is received in IWU2, P2 compares its sequence number with the current counter value provided by C2.

[0029] If this sequence number is higher than the value of C2, in case of a second packet, or than the value of C2 incremented by 1 when a first packet is received, then P2 stores the packet Pin in B because this means that as well in case of a first packet as in case of a second packet at least one preceding first packet has still to be received. Obviously, the number of first packets still to be received depends on the difference between the value of C2 + 1 and the sequence number of the received packet. In other words, the number of still expected packets is equal to the sequence number of the received packet minus the value of C2 + 1.

[0030] P2 starts a timer, by using T, for each buffered packet. When one of these timers expires it is supposed that all still to be received first packets with sequence number smaller than the sequence number of the packet for which that timer was started are lost and the packet for which the timer has expired is together with all buffered first packets having a sequence number lower than that for which the timer has expired and with all related buffered second packets sequenced in the following way before transmission to R : all packets are ordered in ascending order, with the second packets interleaved with the first packets in such a way that the second packets always follow the first packets with the same sequence number if present and that the sequence of receipt of the second packets is preserved. C2 is then set by P2 to a value equal to the sequence number of the packet of which the timer has expired. The reason for this procedure is that according to a requirement of the system the packets may not stay in the system for longer than a predefined time interval equal to the maximum transmission delay.

[0031] If the received packet is a first packet and its sequence number is equal to the counter value C2 + 1, P2 checks if there are buffered packets. If so, all buffered first packets the sequence numbers of which, with the sequence number of the received packet, form an increasing series with increment value one are retrieved from the buffer together with all second packets having a sequence number equal to the sequence number of the received packet or of one of the retrieved packets. All these packet are then ordered as described earlier. Each time a first packet is passed to R, P2 increments C2 by one and cancels a possible timer started for that packet. If no packets are buffered or if the buffered first packets do not form the mentioned increasing series with the received packet, only the latter is passed to R and C2 is incremented by 1. It has then to be checked whether there are no buffered second packets which have then to be retrieved and passed to R in the sequence they were received.

[0032] Upon receipt of a second packet with sequence number equal to the value of C2, P2 passes this packet to R, since this means that the preceding first packet was already received and passed to R.

[0033] Packets received by P2 and having a lower sequence number than the value of C2 in case of second packets or than the value of C2 + 1 in the case of first packets are discarded. This is correct since in case of a second packet this means that the packet was overtaken by a first packet, whereas in the case of a first packet this means that the received packet was supposed to be lost due to a previous time out.

[0034] To illustrate the above described procedure it is now applied to a transmitted packet stream I0, I0, G1, G2, G3, I3, I3, G4, G5, G6, I6, I6, I6, G7, I7 which is after start-up of the resequencing circuit received by P2 as I0, G1, I0, G2, G3, I3, I3, G5, G4, I6, I6, G6, I6, G7, I7.

[0035] After a generally known synchronization procedure C2 is set to an initial value of 0 by P2. Upon receipt of I0 by P2, the latter transmits I0 to R. When G1 is received its sequence number is compared with the value of C2 which is 0. This indicates that the next to be received first packet has to have sequence number one and consequently G1 is passed to R. Thereafter it is checked if there are no buffered packets, and C2 is incremented to 1, which means that the next expected first packet has sequence number 2. The following packet I0 is discarded because it has a sequence number lower than the value of C2 and was thus overtaken by G1. G2 has a sequence number corresponding to the next to receive sequence number and is thus passed by P2 to R. Thereafter B is checked for possible buffered packets, and C2 is incremented to 2. The same applies to G3 and C2 is incremented to 3. The two following packets I3, I3 are second packets the sequence number of which is equal to the value of C2 which means that the preceding first packet had sequence number 3 and as a consequence the packets are passed to R. When G5 is received P2 detects that it is not the following expected first packet which has a sequence number equal to the value of C2 + 1 = 4. G5 is therefore buffered and a timer is started for G5 by T

under control of P2. It is assumed that G4 is received before the timer has reached a predetermined value corresponding to the maximum transmission delay in the network. Since the sequence number of G4 corresponds to the value of the next expected first packet, i.e. C2 + 1, P2 checks if there are packets buffered and retrieves G5 from B. The timer is stopped and the received and the retrieved packets are sequenced as G4, G5 and transmitted to R, whilst C2 is twice incremented to become 5. Had the timer expired before G4 was received, then G4 would have supposed to be lost and G5 would have been retrieved from B and transmitted to R and C2 would then have put equal to 5 by P2.

[0036] When the packets I6, I6 are received, P2 detects that these are second packets and thus should have a sequence number corresponding to the value of C2, i.e. 5. Since this is not true and because their sequence number is higher, they are buffered and G6 is expected. Upon receipt of G6, P2 finds out it is a first packet which should have the value of C2 + 1, i.e. 6. Since this is the case P2 checks if there are no packets buffered, retrieves I6, I6 from B and sends the packets to R in the sequence G6, I6, I6. C2 is incremented to 6. The then received packet I6 is passed to R because C2 equals 6. Since C2 has value 6, P2 expects as following first packet G7,which is therefore passed to R. It is checked whether there are packets buffered and C2 is incremented. I7 is then passed to R because its sequence number has the same value as C2, which means that a previous first packet with sequence number 7 was received.

[0037] It has to be noted that the above method can be applied in a similar way when the increment value is greater than 1, or for decrements with a predetermined value. Also another relationship can be chosen between the sequence numbers of the second packets and the preceding first packet.

[0038] It has also to be noted that, since messages can also be transmitted from IWU2 to IWU1, a sequence allocation circuit and a resequencing circuit such as those of IWU1 and IWU2 are also present in IWU2 and IWU1 respectively.

Claims

1. Method for resequencing information packets of an information packet stream (Min) transmitted from a transmitter station (IWU1) to a receiver station (IWU2) over a network (SMDS) and identified by sequence numbers, characterized in that,for first packets included in said information packet stream (Min) and received in said receiver station (IWU2) out of sequence with respect to each other or with respect to second packets which are always received in sequence, said method includes the steps of :

   - in said transmitter station (IWU1), allocating predetermined first sequence numbers to said first packets and allocating to each second packet following a first packet a second sequence number which is related according to a predetermined relation to the predetermined first sequence number allocated to this first packet; and
   - in said receiver station (IWU2), resequencing said first and second packets according to their first and second sequence numbers respectively.

2. Method according to claim 1, characterized in that said predetermined first sequence numbers allocated to said first packets form an increasing/decreasing monotonous series.

3. Method according to claim 1, characterized in that said second sequence number allocated to said second packet is equal to the predetermined first sequence number of the first packet preceding said second packet.

4. Method according to claims 2 and 3, characterized in that a second packet is discarded in said receiver station (IWU2) when its said second sequence number is smaller/greater than the predetermined first sequence number of a previously received first packet.

5. Method according to claims 2 and 3, characterized in that received second packets which have a same second sequence number which is larger smaller than the predetermined first sequence number of the previously received first packet are buffered until receipt of a first packet having a predetermined first sequence number equal to the second sequence number of the thus buffered second packets.

6. Method according to claims 2 and 3, characterized in that upon receipt in said receiver station (IWU2) of one of said first packets from said transmitter station (IWU1) said first packet is buffered when its predetermined first sequence number is larger/smaller than the sequence number of the last previously received and not buffered packet incremented/decremented by a predetermined value, that upon receipt by said receiver station (IWU2) of one of said second packets from said transmitter station (IWU1), said second packet is buffered when its second sequence number is larger/smaller than the sequence number of the last previously received and not buffered packet, that upon receipt by said receiver station (IWU2) of a second packet with a said second sequence number equal to the sequence number of the last previously received and not buffered packet or of a first packet with a

said predetermined sequence number equal to the sequence number of the last previously received and not buffered packet incremented/decremented by said predetermined value, said packet is passed to an output terminal (R) of said receiver station (IWU2), those already buffered first packets, the first sequence numbers of which together with the sequence number of the passed first packet form part of said monotonous series also being passed to said output terminal (R), in ascending/descending order of their first sequence number, together with those second packets having a said second sequence number equal to a previously passed packet, and that upon receipt of a said second packet having a said second sequence number smaller/larger than the sequence number of the last previously received and not buffered packet or of a first packet having a predetermined first sequence number smaller/larger than the sequence number of the last previously received and not buffered packet incremented/decremented by said predetermined value, said packet is discarded.

7. Method according to claim 6, characterized in that a timer is started for each one of said buffered packets, all buffered packets with sequence number smaller/greater than the sequence number of said one packet, and all buffered packets with sequence number greater/smaller than the sequence number of said one packet and which form with said one packet part of said monotonous series, being passed to said output terminal (R) after having been sequenced to form a series of packets related to said monotonous series in a predetermined way, when said timer (T) reaches a predetermined value.

8. Method according to claim 1, characterized in that in said network (SMDS) said second packets have an individual destination address and are sent from said transmitter station (IWU1) to said receiver station (IWU2) and said first packets have a group destination address and are sent from said transmitter station (IWU1) to said receiver station (IWU2) and to at least one other receiver station (IWU3, IWU4).

9. Method according to claim 1, characterized in that a predetermined initial value is assigned to the second sequence number of all second packet which are transmitted before the transmission of any first packet.

10. Resequencing device for resequencing information packets of an information packet stream (Min) transmitted from a transmitter station (IWU1) to a receiver station (IWU2) over a network (SMDS) and identified by sequence numbers characterized in that, for first packets included in said information packet stream (Min) which are received in said receiver station (IWU2) out of sequence with respect to each other or with respect to second packets which are always received in sequence, said resequencing device includes :

- a sequence number allocation means (P1, C1) located in said transmitter station (IWU1) and which is adapted to allocate predetermined first sequence numbers to said first packets and to allocate to each second packet following a first packet a second sequence number which is related according to a predetermined relation to the predetermined first sequence number allocated to this first packet; and
- a resequencing means (P2, B, C2, T) located in said receiver station (IWU2) and which is adapted to resequence said first and second packets according to their first and second sequence numbers respectively.

11. Resequencing device according to claim 10, characterized in that said predetermined first sequence numbers allocated to said first packets form an increasing/decreasing monotonous series.

12. Resequencing device according to claim 10, characterized in that said second sequence number allocated to said second packet is equal to the predetermined first sequence number of the first packet preceding said second packet.

13. Resequencing device according to claims 11 and 12, characterized in that said sequence number allocation means (P1, C1) includes a counter means (C1) adapted to provide a counter value and a processing means (P1) which is adapted to assign said counter value to said second packets to be transmitted and is adapted to control said counter means to be incremented/decremented by a predetermined value before assigning said counter value to said first packets to be transmitted.

14. Resequencing device according to claims 11 and 12, characterized in that said resequencing means (P2, B, C2, T) includes a buffering means (B) adapted to buffer received second packets having a same second sequence number which is larger/smaller than the sequence number of the last previously received and not buffered packet until receipt of a first packet having a predetermined first sequence number equal to the second sequence number of the thus buffered second packets.

15. Resequencing device according to claims 13 and 14, characterized in that said resequencing means (P2, B, C2, T) includes at least one second counter means (C2) providing a second counter value the initial value of which is at start-up of said rese-

quencing means made equal to the initial value of said first counter (C1) and a second processing means (P2) which, upon receipt of one of said first packets from said transmitter station (IWU1), is adapted to buffer said first packet in said buffering means (B) when its predetermined first sequence number is larger/smaller than said second counter value incremented/decremented by said predetermined value, which, upon receipt of one of said second packets from said transmitter station (IWU1), is adapted to buffer said second packet in said buffering means (B) when its second sequence number is larger/smaller than said second counter value, which, upon receipt of a second packet with a second sequence number equal to said second counter value or of a first packet with a predetermined first sequence number equal to said second counter value incremented/decremented by said predetermined value, is adapted to pass said packet to an output terminal (R) of said resequencing means and to control said second counter means (C2) to be incremented/decremented by said predetermined value when a said first packet is passed to said output terminal (R), those already buffered first packets the first sequence numbers of which together with the first sequence number of the first passed packet form part of said monotonous series and those second packets having a second sequence number equal to the sequence number of either the passed or of one of those buffered first packets then also being passed to said output terminal (R) in such a way that those buffered first packets are sequenced in ascending/descending order of their sequence number, together with buffered second packets sequenced in such a way with respect to said passed first packets that they follow a first packet having the same predetermined first sequence number as their own second sequence number, and which, upon receipt of a second packet having a second sequence number smaller/larger than said counter value or of a first packet having a predetermined first sequence number smaller/larger than said counter value incremented/decremented by said predetermined value, is adapted to discard said packet.

16. Resequencing device according to claim 15, characterized in that said resequencing means includes a timer means (T), controlled by said second processing means (P2), adapted to start a timer for each one of said buffered packets, all buffered packets with sequence number smaller/greater than the sequence number of said one packet, and all buffered packets with sequence number greater/smaller than the sequence number of said one packet and which form with said one packet part of said monotonous series, being passed to said output terminal (R) after having been sequenced to form a series of packets related to said monotonous series in a predetermined way, when said timer reaches a predetermined value.

17. Resequencing device according to claim 10, characterized in that in said network (SMDS) said second packets have an individual destination address and are sent from said transmitter station (IWU1) to said receiver station (IWU2) and said first packets have a group destination address and are sent from said transmitter station (IWU1) to said receiver station (IWU2) and to at least one other receiver station (IWU3, IWU4).

Patentansprüche

1. Verfahren zum sequentiellen Rückordnen von Informationspaketen eines Informationspaketstromes (Min), der über ein Netz (SMDS) von einer Sendestation (IWU1) zu einer Empfangsstation (IWU2) gesendet wird und durch Sequenznummern identifiziert ist, dadurch gekennzeichnet, daß für erste Pakete, die im Informationspaketstrom (Min) enthalten sind und in der Empfangsstation (IWU2) nicht mehr sequentiell geordnet empfangen werden, und zwar bezüglich zueinander oder bezüglich zweiter Pakete, welche immer sequentiell geordnet empfangen werden, das Verfahren folgende Schritte beinhaltet:

   - in der Sendestation (IWU1) werden vorbestimmte erste Sequenznummern den ersten Paketen zugeordnet und jedem auf ein erstes Paket folgenden zweiten Paket eine zweite Sequenznummer zugeordnet, welche zur diesem ersten Paket zugewiesenen vorbestimmten ersten Sequenznummer eine vorbestimmte Beziehung besitzt; und

   - in der Empfangsstation (IWU2) werden die ersten und zweiten Pakete gemäß ihrer ersten bzw. zweiten Sequenznummern sequentiell rückgeordnet.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die den ersten Paketen zugeordneten vorbestimmten ersten Sequenznummern eine zunehmende/abnehmende monotone Reihe bilden.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die dem zweiten Paket zugeordnete zweite Sequenznummer gleich der vorbestimmten ersten Sequenznummer des dem zweiten Paket vorangehenden ersten Paketes ist.

4. Verfahren nach den Ansprüchen 2 und 3, dadurch gekennzeichnet, daß ein zweites Paket in der Emp-

fangsstation (IWU2) verworfen wird, wenn seine zweite Sequenznummer kleiner/größer als die vorbestimmte erste Sequenznummer eines vorher empfangenen ersten Paketes ist.

5. Verfahren nach den Ansprüchen 2 und 3, dadurch gekennzeichnet, daß empfangene zweite Pakete, welche eine gleiche zweite Sequenznummer besitzen, die größer/kleiner ist als die vorbestimmte erste Sequenznummer des vorher empfangenen ersten Paketes, bis zum Empfangen eines ersten Paketes gepuffert werden, das eine vorbestimmte erste Sequenznummer besitzt, die gleich der zweiten Sequenznummer der auf diese Weise gepufferten zweiten Pakete ist.

6. Verfahren nach den Ansprüchen 2 und 3, dadurch gekennzeichnet, daß beim Empfangen in der Empfangsstation (IWU2) von einem der von der Sendestation (IWU1) kommenden ersten Pakete das erste Paket gepuffert wird, wenn seine vorbestimmte erste Sequenznummer größer/kleiner ist als die Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes, die um einen vorbestimmten Wert erhöht/vermindert wurde, daß beim Empfangen durch die Empfangsstation (IWU2) von einem der von der Sendestation (IWU1) kommenden zweiten Pakete das zweite Paket gepuffert wird, wenn seine zweite Sequenznummer größer/Meiner ist als die Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes, daß beim Empfangen durch die Empfangsstation (IWU2) eines zweiten Paketes, dessen zweite Sequenznummer gleich der Sequenznummer des letzten vorher empfangenen nicht gepufferten Paketes oder eines ersten Paketes ist, dessen vorbestimmte Sequenznummer gleich der Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes ist, die um den vorbestimmten Wert erhöht/vermindert wurde, das Paket zu einem Ausgangsanschluß (R) der Empfangsstation (IWU2) weitergeleitet wird, diese bereits gepufferten ersten Pakete, deren erste Sequenznummern zusammen mit der Sequenznummer des weitergeleiteten ersten Paketes einen Teil der monotonen Reihe bilden, ebenfalls zu dem Ausgangsanschluß (R) in aufsteigender/absteigender Reihenfolge ihrer ersten Sequenznummer weitergeleitet werden, und zwar zusammen mit den zweiten Paketen, deren zweite Sequenznummer gleich einem zuvor weitergeleiteten Paket ist, und daß beim Empfangen eines zweiten Paketes, dessen zweite Sequenznummer kleiner/größer ist als die Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes oder eines ersten Paketes, dessen vorbestimmte erste Sequenznummer kleiner/größer ist als die Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes, die um den vorbestimmten Wert erhöht/vermindert ist, das Paket verworfen wird.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß ein Zeitgeber für jedes einzelne der gepufferten Pakete gestartet wird, alle gepufferten Pakete, deren Sequenznummer kleiner/größer ist als die Sequenznummer dieses einen Paketes, und alle gepufferten Pakete, deren Sequenznummer größer/kleiner ist als die Sequenznummer dieses einen Pakets und welche mit diesem einen Paket einen Teil der monotonen Reihe bilden, zu dem Ausgangsanschluß (R) weitergeleitet werden, und zwar nachdem sie sequentiell geordnet wurden, um eine Reihe von Paketen zu bilden, die zu der monotonen Reihe in vorbestimmter Weise in Beziehung steht, wenn der Zeitgeber (T) einen vorbestimmten Wert erreicht.

8. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß in dem Netz (SMDS) die zweiten Pakete eine individuelle Bestimmungsadresse besitzen und von der Sendestation (IWU1) an die Empfangsstation (IWU2) gesendet werden, und die ersten Pakete eine Gruppen-Bestimmungsadresse besitzen und von der Sendestation (IWU1) an die Empfangsstation (IWU2) und an mindestens eine weitere Empfangsstation (IWU3, IWU4) gesendet werden.

9. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der zweiten Sequenznummer aller zweiten Pakete, welche vor dem Senden von irgendeinem ersten Paket gesendet werden, ein vorbestimmter Anfangswert zugewiesen wird.

10. Sequentielle Rückordnungsvorrichung zum sequentiellen Rückordnen von Informationspaketen eines Informationspaketstromes (Min), der über ein Netz (SMDS) von einer Sendestation (IWU1) zu einer Empfangsstation (IWU2) gesendet wird und durch Sequenznummern identifiziert ist, dadurch gekennzeichnet, daß für erste Pakete, die im Informationspaketstrom (Min) enthalten sind und in der Empfangsstation (IWU2) nicht mehr sequentiell geordnet empfangen werden, und zwar bezüglich zueinander oder bezüglich zweiter Pakete, welche immer sequentiell geordnet empfangen werden, die sequentielle Rückordnungsvorrichtung beinhaltet:

   - eine Sequenznummern-Zuordungseinrichtung (P1, C1), welche sich in der Sendestation (IWU1) befindet und geeignet ist, vorbestimmte erste Sequenznummern den ersten Paketen zuzuordnen und jedem auf ein erstes Paket folgenden zweiten Paket eine zweite Sequenznummer zuzuordnen, welche zur diesem

ersten Paket zugewiesenen vorbestimmten ersten Sequenznummer eine vorbestimmte Beziehung besitzt; und

- eine sequentielle Rückordnungseinrichtung (P2, B, C2, T), welche sich in der Empfangsstation (IWU2) befindet und geeignet ist, die ersten und zweiten Pakete gemäß ihrer ersten bzw. zweiten Sequenznummern sequentiell rückzuordnen.

11. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß die den ersten Paketen zugeordneten vorbestimmten ersten Sequenznummern eine zunehmende/abnehmende monotone Reihe bilden.

12. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß die dem zweiten Paket zugeordnete zweite Sequenznummer gleich der vorbestimmten ersten Sequenznummer des dem zweiten Paket vorangehenden ersten Paketes ist.

13. Sequentielle Rückordnungsvorrichtung nach den Ansprüchen 11 und 12, dadurch gekennzeichnet, daß die Sequenznummern-Zuordnungseinrichtung (P1, C1) eine Zähleinrichtung (C1) beinhaltet, die geeignet ist, einen Zählwert zu liefern, und eine Verarbeitungseinrichtung (P1), welche geeignet ist, diesen Zählwert den zweiten zu sendenden Paketen zuzuweisen und geeignet ist, die Zähleinrichtung so zu steuern, daß sie um einen vorbestimmten Wert erhöht/vermindert wird, bevor der Zählwert den zu sendenden ersten Paketen zugewiesen wird.

14. Sequentielle Rückordnungsvorrichtung nach den Ansprüchen 11 und 12, dadurch gekennzeichnet, daß die sequentielle Rückordnungseinrichtung (P2, B, C2, T) eine Puffereinrichtung (B) beinhaltet, welche geeignet ist, zweite empfangene Pakete, die eine gleiche zweite Sequenznummer besitzen, welche größer/kleiner ist als die Sequenznummer des letzten vorher empfangenen und nicht gepufferten Paketes, zu puffern, bis ein erstes Paket empfangen wird, welches eine vorbestimmte erste Sequenznummer besitzt, die gleich der zweiten Sequenznummer der auf diese Weise gepufferten zweiten Pakete ist.

15. Sequentielle Rückordnungsvorrichtung nach den Ansprüchen 13 und 14, dadurch gekennzeichnet, daß die sequentielle Rückordnungseinrichtung (P2, B, C2, T) mindestens eine zweite Zähleinrichtung (C2) beinhaltet, welche einen zweiten Zählwert liefert, deren Anfangswert beim Hochfahren der sequentiellen Rückordnungseinrichtung gleich dem Anfangswert der ersten Zähleinrichtung (C1) ist, und eine zweite Verarbeitungseinrichtung (P2), welche beim Empfangen von einem der ersten Pakete von der Sendesstation (IWU1) geeignet ist, das erste Paket in der Puffereinrichtung (B) zu puffern, wenn dessen vorbestimmte erste Sequenznummer größer/kleiner ist als der um den vorbestimmten Wert erhöhte/verminderte zweite Zählwert, welche beim Empfangen eines der zweiten Pakete von der Sendestation (IWU1) geeignet ist, das zweite Paket in der Puffereinrichtung (B) zu puffern, wenn dessen zweite Sequenznummer größer/kleiner ist als der zweite Zählwert, welche beim Empfangen eines zweiten Paketes, dessen zweite Sequenznummer gleich dem zweiten Zählwert ist, oder beim Empfangen eines ersten Paketes mit einer vorbestimmten ersten Sequenznummer, die gleich dem um den vorbestimmten Wert erhöhten/verminderten zweiten Zählwert ist, geeignet ist, das Paket an einen Ausgangsanschluß (R) der sequentiellen Rückordnungseinrichtung weiterzuleiten und die zweite Zähleinrichtung (C2) so zu steuern, daß sie um den vorbestimmten Wen erhöht/vermindert wird, wenn ein erstes Paket an den Ausgangsanschluß (R) weitergeleitet wird, wobei diese bereits gepufferten ersten Pakete, deren erste Sequenznummern zusammen mit der ersten Sequenznummer des ersten weitergeleiteten Paketes einen Teil der monotonen Reihe bilden, und diese zweiten Pakete, deren zweite Sequenznummer gleich der Sequenznummer von entweder den weitergeleiteten oder von einem dieser gepufferten ersten Pakete ist, dann ebenfalls an den Ausgangsanschluß (R) weitergeleitet wird, derart, daß diese gepufferten ersten Pakete in aufsteigender/absteigender Reihenfolge ihrer Sequenznummer sequentiell geordnet werden, zusammen mit gepufferten zweiten Paketen, die bezüglich den weitergeleiteten ersten Paketen derart sequentiell geordnet sind, daß sie auf ein erstes Paket folgen, welches die gleiche vorbestimmte erste Sequenznummer wie diese zweite Sequenznummer besitzt, und welche, beim Empfangen eines zweiten Paketes, dessen zweite Sequenznummer kleiner/größer als dieser Zählwert ist, oder beim Empfangen eines ersten Paketes, dessen vorbestimmte erste Sequenznummer kleiner/größer als der um den vorbestimmten Wert erhöhte/verminderte Zählwert ist, geeignet ist, dieses Paket zu verwerfen.

16. Sequentielle Rückordnungsvorrichtung nach Anspruch 15, dadurch gekennzeichnet, daß die sequentielle Rückordnungseinrichtung einen Zeitgebereinrichtung (T) beinhaltet, die von der zweiten Verarbeitungseinrichtung (P2) gesteuert wird, welche geeignet ist, einen Zeitgeber für jedes einzelne der gepufferten Pakete zu starten, wobei alle gepufferten Pakete, deren Sequenznummer kleiner/größer ist als die Sequenznummer dieses

einen Paketes, und alle gepufferten Pakete, deren Sequenznummer größer/kleiner als die Sequenznummer von diesem einen Paket ist und welche mit diesem einen Paket einen Teil der monotonen Reihe bilden, zu dem Ausgangsanschluß (R) weitergeleitet werden, und zwar nachdem sie sequentiell geordnet wurden, um eine Reihe von Paketen zu bilden, die zu der monotonen Reihe in vorbestimmter Weise in Beziehung steht, wenn der Zeitgeber (T) einen vorbestimmten Wert erreicht.

17. Sequentielle Rückordnungsvorrichtung nach Anspruch 10, dadurch gekennzeichnet, daß in dem Netz (SMDS) die zweiten Pakete eine individuelle Bestimmungsadresse besitzen und von der Sendestation (IWU1) an die Empfangsstation (IWU2) gesendet werden, und die ersten Pakete eine Gruppen-Bestimmungsadresse besitzen und von der Sendestation (IWU1) an die Empfangsstation (IWU2) und an mindestens eine weitere Empfangsstation (IWU3, IWU4) gesendet werden.

Revendications

1. Procédé de remise en séquence de paquets d'informations d'un courant de paquets d'informations (Min) transmis depuis une station émettrice (IWU1) vers une station réceptrice (IWU2) sur un réseau (SMDS) et identifiés par des numéros de séquence, caractérisé en ce que, pour les premiers paquets inclus dans ledit courant de paquets d'informations (Min) et reçus dans ladite station réceptrice (IWU2) hors séquence les uns par rapport aux autres ou par rapport à des deuxièmes paquets qui sont toujours reçus en séquence, ledit procédé comporte les étapes consistant à :

   - dans ladite station émettrice (IWU1), allouer des premiers numéros de séquence prédéterminés auxdits premiers paquets et allouer à chaque deuxième paquet suivant un premier paquet, un deuxième numéro de séquence qui est lié selon une relation prédéterminée au premier numéro de séquence prédéterminé alloué à ce premier paquet ; et
   - dans ladite station réceptrice (IWU2), remettre en séquence lesdits premiers et deuxièmes paquets, respectivement en fonction de leurs premiers et deuxièmes numéros de séquence.

2. Procédé selon la revendication 1, caractérisé en ce que lesdits premiers numéros de séquence prédéterminés alloués auxdits premiers paquets forment une serie monotone croissante/décroissante.

3. Procédé selon la revendication 1, caractérisé en ce que ledit deuxième numéro de séquence alloué audit deuxième paquet est égal au premier numéro de séquence prédéterminé du premier paquet précédent ledit deuxième paquet.

4. Procédé selon les revendications 2 et 3, caractérisé en ce qu'un deuxième paquet est éliminé dans ladite station réceptrice (IWU2) lorsque son dit deuxième numéro de séquence est inférieur/supérieur au premier numéro de séquence prédéterminé d'un premier paquet précédemment reçu.

5. Procédé selon les revendications 2 et 3, caractérisé en ce que les deuxièmes paquets reçus ayant un même deuxième numéro de séquence supérieur/inférieur au premier numéro de séquence prédéterminé du premier paquet précédemment reçu sont retenus jusqu'à réception d'un premier paquet ayant un premier numéro de séquence prédéterminé égal au deuxième numéro de séquence des deuxièmes paquets ainsi retenus.

6. Procédé selon les revendications 2 et 3, caractérisé en ce que, lors de la réception dans ladite station réceptrice (IWU2) de l'un desdits premiers paquets depuis ladite station émettrice (IWU1), ledit premier paquet est retenu lorsque son premier numéro de séquence prédéterminé est supérieur/inférieur au numéro de séquence du dernier paquet précédemment reçu et non retenu incrémenté/décrémenté d'une valeur prédéterminée, en ce que lors de la réception par ladite station réceptrice (IWU2) de l'un desdits deuxièmes paquets depuis ladite station émettrice (IWU1), ledit deuxième paquet est retenu lorsque son deuxième numéro de séquence est supérieur/inférieur au numéro de séquence du dernier paquet précédemment reçu et non retenu, en ce que lors de la réception par ladite station réceptrice (IWU2) d'un deuxième paquet avec un dit deuxième numéro de séquence égal au numéro de séquence du dernier paquet précédemment reçu et non retenu ou d'un premier paquet avec un dit numéro de séquence prédéterminé égal au numéro de séquence du dernier paquet précédemment reçu et non retenu incrémenté/décrémenté de ladite valeur prédéterminée, ledit paquet est transmis à une borne de sortie (R) de ladite station réceptrice (IWU2), ces premiers paquets déjà retenus, dont les premiers numéros de séquence avec le numéro de séquence du premier paquet transmis font partie de ladite série monotone également transmis à ladite borne de sortie (R), en ordre ascendant/descendant de leurs premiers numéros de séquence, ainsi que les deuxièmes paquets ayant un dit deuxième numéro de séquence égal à un paquet précédemment transmis et en ce que lors de la réception d'un dit deuxième paquet ayant un dit deuxième numéro de séquence inférieur/supérieur au numéro de séquence du dernier paquet précédemment reçu et non retenu ou d'un

premier paquet ayant un premier numéro de séquence prédéterminé inférieur/supérieur au numéro de séquence du dernier paquet précédemment reçu et non retenu incrémenté/décrémenté de ladite valeur prédéterminée, ledit paquet est éliminé.

7. Procédé selon la revendication 6, caractérisé en ce qu'un séquenceur est démarré pour chacun desdits paquets retenus, tous les paquets retenus avec un numéro de séquence inférieur/supérieur au numéro de séquence dudit premier paquet et tous les paquets retenus avec un numéro de séquence supérieur/inférieur au numéro de séquence dudit premier paquet et qui, avec ledit premier paquet, font partie de ladite série monotone, transmise à ladite borne de sortie (R) après avoir été séquencés de manière à former une série de paquets liée à ladite série monotone d'une manière prédéterminée, lorsque ledit séquenceur atteint une valeur prédéterminée.

8. Procédé selon la revendication 1, caractérisé en ce que dans ledit réseau (SMDS), lesdits deuxièmes paquets ont une adresse de destination individuelle et sont envoyés de ladite station émettrice (IWU1) à ladite station réceptrice (IWU2) et lesdits premiers paquets ont une adresse de destination de groupe et sont envoyés de ladite station émettrice (IWU1) à ladite station réceptrice (IWU2) et à au moins une autre station réceptrice (IWU3, IWU4).

9. Procédé selon la revendication 1, caractérisé en ce qu'une valeur initiale prédéterminée est assignée au deuxième numéro de séquence de l'ensemble des deuxièmes paquets qui sont transmis avant la transmission d'un quelconque premier paquet.

10. Dispositif de remise en séquence pour remettre en séquence des paquets d'informations d'un courant de paquets d'informations (Min) transmis d'une station émettrice (IWU1) à une station réceptrice (IWU2) sur un réseau (SMDS) et identifiés par des numéros de séquence, caractérisé en ce que, pour des premiers paquets inclus dans ledit courant de paquets d'informations (Min) qui sont reçus dans ladite station réceptrice (IWU2) hors séquence les uns par rapport aux autres ou par rapport aux deuxièmes paquets qui sont toujours reçus en séquence, ledit dispositif de remise en séquence comporte :

- des moyens d'allocations de numéros de séquence (P1; C1) situés dans ladite station émettrice (IWU1) et qui sont adaptés pour allouer des premiers numéros de séquence prédéterminés auxdits premiers paquets et allouer à chaque deuxième paquet suivant un premier paquet, un deuxième numéro de séquence qui est lié selon une relation prédéterminée au premier numéro de séquence prédéterminé alloué à ce premier paquet ; et

- des moyens de remise en séquence (P2, B, C2, T) situés dans ladite station réceptrice (IWU2) et qui sont adaptés pour remettre en séquence lesdits premiers et deuxièmes paquets respectivement en fonction de leurs premiers et deuxièmes numéros de séquence.

11. Dispositif de remise en séquence selon la revendication 10, caractérisé en ce que lesdits premiers numéros de séquence prédéterminés alloués auxdits premiers paquets forment une série monotone croissante/décroissante.

12. Dispositif de remise en séquence selon la revendication 10, caractérisé en ce que ledit deuxième numéro de séquence alloué audit deuxième paquet est égal au premier numéro de séquence prédéterminé du premier paquet précédent ledit deuxième paquet.

13. Dispositif de remise en séquence selon les revendications 11 et 12, caractérisé en ce que lesdits moyens d'allocations de numéro de séquence (P1, C1) comportent des moyens formant compteur (C1) adaptés pour fournir une valeur de compteur et des moyens de traitement (P1) adaptés pour assigner ladite valeur de compteur auxdits deuxièmes paquets à transmettre et adaptés pour contrôler lesdits moyens formant compteur pour être incrémentés/décrémentés d'une valeur prédéterminée avant d'assigner ladite valeur de compteur auxdits premiers paquets à transmettre.

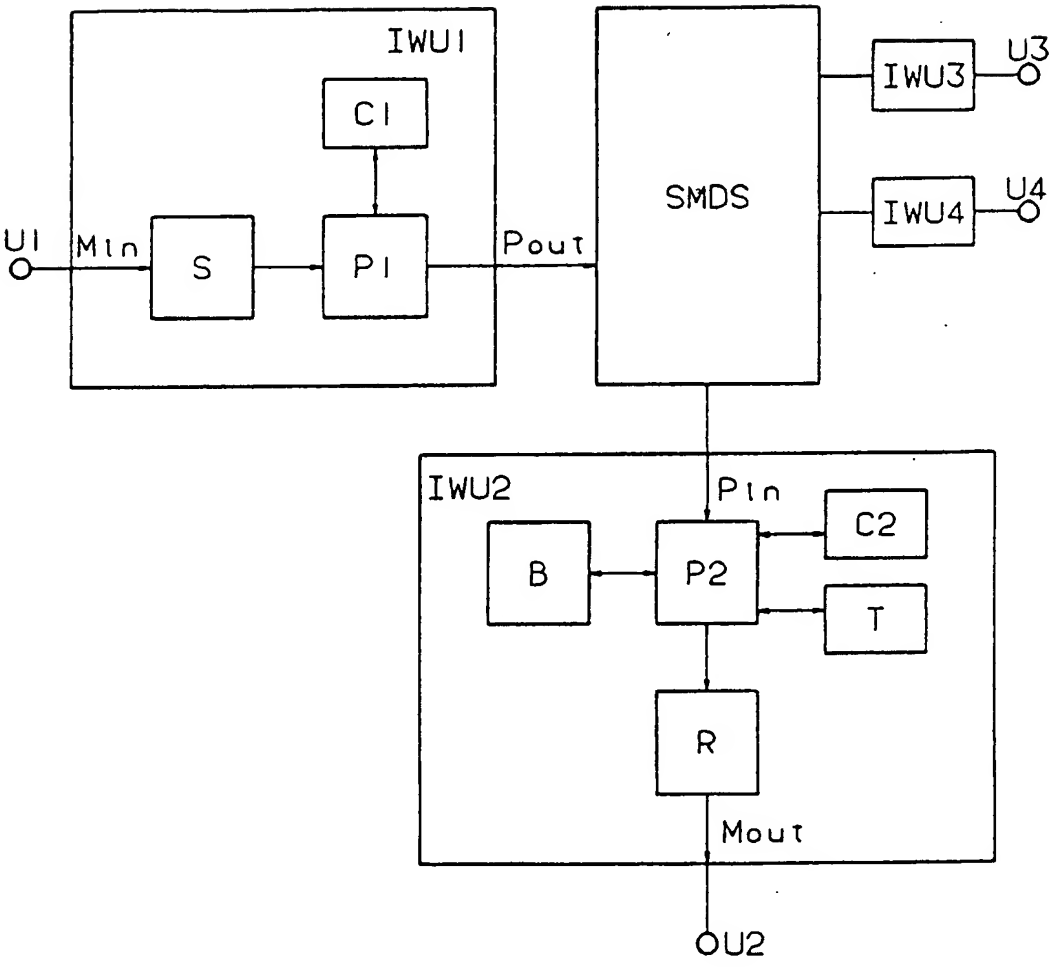
14. Dispositif de remise en séquence selon les revendications 11 et 12, caractérisé en ce que lesdits moyens de remise en séquence (P2, B, C2, T) comportent des moyens de retenue (B) adaptés pour retenir les deuxièmes paquets reçus ayant un deuxième numéro de séquence qui est supérieur/inférieur au numéro de séquence du dernier paquet précédemment reçu et non retenu jusqu'à réception d'un premier paquet ayant un premier numéro de séquence prédéterminé égal au deuxième numéro de séquence des deuxièmes paquets ainsi retenus.

15. Dispositif de remise en séquence selon les revendications 13 et 14, caractérisé en ce que lesdits moyens de remise en séquence (P2, B, C2, T) comportent au moins des deuxièmes moyens formant compteur (C2) fournissant une deuxième valeur de compteur dont la valeur initiale est, au démarrage desdits moyens de remise en séquence, rendue

égale à la valeur initiale dudit premier compteur (C1) et des deuxièmes moyens de traitement (P2) qui, lors de la réception de l'un desdits premiers paquets depuis ladite station émettrice (IWU1), sont adaptés pour retenir ledit premier paquet dans lesdits moyens de retenue (B) lorsque son premier numéro de séquence prédéterminé est supérieur/inférieur à ladite deuxième valeur de compteur incrémentée/décrémentée de ladite valeur prédéterminée, qui, lors de la réception de l'un desdits deuxièmes paquets depuis ladite station émettrice (IWU1), sont adaptés pour retenir ledit deuxième paquet dans lesdits moyens de retenue (B) lorsque son deuxième numéro de séquence est supérieur/inférieur à ladite deuxième valeur de compteur, qui, lors de la réception d'un deuxième paquet avec un dit deuxième numéro de séquence égal à ladite deuxième valeur de compteur ou d'un premier paquet avec un premier numéro de séquence prédéterminé égal à ladite deuxième valeur de compteur incrémentée/décrémentée de ladite valeur prédéterminée, sont adaptés pour transmettre ledit paquet à une borne de sortie (R) desdits moyens de remise en séquence et pour contrôler lesdits deuxièmes moyens formant compteur (C2) pour être incrémentés/décrémentés de ladite valeur prédéterminée lorsqu'un premier paquet est transmis à ladite borne de sortie (R), les premiers paquets déjà retenus dont les premiers numéros de séquence avec le premier numéro de séquence du premier paquet transmis font partie de ladite série monotone et les deuxièmes paquets ayant un deuxième numéro de séquence égal au numéro de séquence, soit des paquets transmis, soit de l'un de ces premiers paquets retenus, également transmis ensuite à ladite borne de sortie (R) d'une manière telle que ces premiers paquets retenus sont séquencés en ordre ascendant/descendant de leur numéro de séquence, ainsi que les deuxièmes paquets retenus séquencés d'une manière telle par rapport auxdits premiers paquets transmis qu'ils suivent un premier paquet ayant le même premier numéro de séquence prédéterminé que leurs propres deuxièmes numéros de séquence et qui, lors de la réception d'un deuxième paquet ayant un deuxième numéro de séquence inférieur/supérieur à ladite valeur de compteur d'un premier paquet ayant un premier numéro de séquence prédéterminé inférieur/supérieur à ladite valeur de compteur incrémentée/décrémentée de ladite valeur prédéterminée, sont adaptés pour éliminer ledit paquet.

16. Dispositif de remise en séquence selon la revendication 15, caractérisé en ce que lesdits moyens de remise en séquence comportent des moyens formant séquenceur (T), contrôler par lesdits deuxièmes moyens de traitement (P2), adaptés pour démarrer un séquenceur pour chacun desdits paquets retenus, tous les paquets retenus avec un numéro de séquence inférieur/supérieur au numéro de séquence dudit premier paquet et tous les paquets retenus avec un numéro de séquence supérieur/inférieur au numéro de séquence dudit premier paquet et qui, avec ledit premier paquet, font partie de ladite série monotone, transmise à ladite borne de sortie (R) après avoir été séquencés de manière à former une série de paquets liée à ladite série monotone d'une manière prédéterminée, lorsque ledit séquenceur atteint une valeur prédéterminée.

17. Dispositif de remise en séquence selon la revendication 10, caractérisé en ce que dans ledit réseau (SMDS), lesdits deuxièmes paquets ont une adresse de destination individuelle et sont envoyés depuis ladite station émettrice (IWU1) à ladite station réceptrice (IWU2) et lesdits premiers paquets ont une adresse de destination de groupe et sont envoyés de ladite station émettrice (IWU1) à ladite station réceptrice (IWU2) et à au moins une autre station réceptrice (IWU3, IWU4).


IWU1
C1
U1
Min
S
P1
Pout
SMDS
IWU3
U3
IWU4
U4
IWU2
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C2
B
P2
T
R
Mout
OU2